



$$I(J^P) = \frac{1}{2}(0^-)$$

K_S^0 MEAN LIFE

For earlier measurements, beginning with BOLDT 58B, see our 1986 edition, Physics Letters **170B** 130 (1986).

OUR FIT is described in the note on "CP violation in K_L decays" in the K_L^0 Particle Listings. The result labeled "OUR FIT Assuming CPT" ["OUR FIT Not assuming CPT"] includes all measurements except those with the comment "Not assuming CPT" ["Assuming CPT"]. Measurements with neither comment do not assume CPT and enter both fits.

VALUE (10^{-10} s)	EVTS	DOCUMENT ID	TECN	COMMENT
0.8954 ± 0.0004 OUR FIT		Error includes scale factor of 1.1. Assuming CPT		
0.89564 ± 0.00033 OUR FIT		Not assuming CPT		
0.89589 ± 0.00070		1,2 ABOUZAID	11 KTEV	Not assuming CPT
0.89623 ± 0.00047		1,3 ABOUZAID	11 KTEV	Assuming CPT
0.89562 ± 0.00029 ± 0.00043	20M	4 AMBROSINO	11 KLOE	Not assuming CPT
0.89598 ± 0.00048 ± 0.00051	16M	LAI	02C NA48	
0.8971 ± 0.0021		BERTANZA	97 NA31	
0.8941 ± 0.0014 ± 0.0009		SCHWINGEN	...95 E773	Assuming CPT
0.8929 ± 0.0016		GIBBONS	93 E731	Assuming CPT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.8965 ± 0.0007		5 ALAVI-HARATI03	KTEV	Assuming CPT
0.8958 ± 0.0013		6 ALAVI-HARATI03	KTEV	Not assuming CPT
0.8920 ± 0.0044	214k	GROSSMAN	87 SPEC	
0.905 ± 0.007		7 ARONSON	82B SPEC	
0.881 ± 0.009	26k	ARONSON	76 SPEC	
0.8926 ± 0.0032 ± 0.0002		8 CARITHERS	75 SPEC	
0.8937 ± 0.0048	6M	GEWENIGER	74B ASPK	
0.8958 ± 0.0045	50k	9 SKJEGGESTAD	...72 HBC	
0.856 ± 0.008	19994	10 DONALD	68B HBC	
0.872 ± 0.009	20000	9,10 HILL	68 DBC	

1 The two ABOUZAID 11 values use the same full KTeV dataset from 1996, 1997, and 1999. The first enters the "assuming CPT" fit and the second enters the "not assuming CPT" fit.

2 ABOUZAID 11 fit has Δm , τ_s , ϕ_ϵ , $\text{Re}(\epsilon'/\epsilon)$, and $\text{Im}(\epsilon'/\epsilon)$ as free parameters. See $\text{Im}(\epsilon'/\epsilon)$ in the " K_L^0 CP violation" section for correlation information.

3 ABOUZAID 11 fit has Δm and τ_s free but constrains ϕ_ϵ to the Superweak value, i.e. assumes CPT. This τ_s value is correlated with their $\Delta m = m_{K_L^0} - m_{K_S^0}$ measurement in the K_L^0 listings. The correlation coefficient $\rho(\tau_s, \Delta m) = -0.670$.

4 Fit to the proper time distribution.

5 This ALAVI-HARATI 03 fit has Δm and τ_s free but constrains ϕ_{+-} to the Superweak value, i.e. assumes CPT. This τ_s value is correlated with their $\Delta m = m_{K_L^0} - m_{K_S^0}$ measurement in the K_L^0 listings. The correlation coefficient $\rho(\tau_s, \Delta m) = -0.396$.

Superseded by ABOUZAID 11.

6 This ALAVI-HARATI 03 fit has Δm , ϕ_{+-} , and $\tau_{K_S^0}$ free. See ϕ_{+-} in the " K_L CP violation" section for correlation information. Superseded by ABOUZAID 11.

7 ARONSON 82 find that K_S^0 mean life may depend on the kaon energy.

8 CARITHERS 75 measures the Δm dependence of the total decay rate (inverse mean life) to be $\Gamma(K_S^0) = [(1.122 \pm 0.004) + 0.16(\Delta m - 0.5348)/\Delta m] 10^{10}/\text{s}$, or, in terms of mean life, CARITHERS 75 measures $\tau_s = (0.8913 \pm 0.0032) - 0.238 [\Delta m - 0.5348] (10^{-10} \text{ s})$. We have adjusted the measurement to use our best values of ($\Delta m = 0.5293 \pm 0.0009$) (10^{10} s^{-1}). Our first error is their experiment's error and our second error is the systematic error from using our best values.

9 HILL 68 has been changed by the authors from the published value (0.865 ± 0.009) because of a correction in the shift due to η_{+-} . SKJEGGESTAD 72 and HILL 68 give detailed discussions of systematics encountered in this type of experiment.

10 Pre-1971 experiments are excluded from the average because of disagreement with later more precise experiments.

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K_S^0 DECAY MODES

Mode	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	
Hadronic modes			
$\Gamma_1 \pi^0 \pi^0$	(30.69 ± 0.05) %		NODE=S012;CLUMP=A
$\Gamma_2 \pi^+ \pi^-$	(69.20 ± 0.05) %		DESIG=2
$\Gamma_3 \pi^+ \pi^- \pi^0$	($3.5^{+1.1}_{-0.9}$) $\times 10^{-7}$		DESIG=1
			DESIG=8
Modes with photons or $\ell\bar{\ell}$ pairs			
$\Gamma_4 \pi^+ \pi^- \gamma$	[a,b] (1.79 ± 0.05) $\times 10^{-3}$		NODE=S012;CLUMP=B
$\Gamma_5 \pi^+ \pi^- e^+ e^-$	(4.79 ± 0.15) $\times 10^{-5}$		DESIG=5
$\Gamma_6 \pi^0 \gamma\gamma$	[a] (4.9 ± 1.8) $\times 10^{-8}$		DESIG=13
$\Gamma_7 \gamma\gamma$	(2.63 ± 0.17) $\times 10^{-6}$	S=3.0	DESIG=14
			DESIG=6
Semileptonic modes			
$\Gamma_8 \pi^\pm e^\mp \nu_e$	[c] (7.04 ± 0.08) $\times 10^{-4}$		NODE=S012;CLUMP=C
$\Gamma_9 \pi^\pm \mu^\mp \nu_\mu$	[c,d] (4.69 ± 0.05) $\times 10^{-4}$		DESIG=11
			DESIG=12
CP violating (CP) and $\Delta S = 1$ weak neutral current (S1) modes			
$\Gamma_{10} 3\pi^0$	CP < 1.2×10^{-7}	CL=90%	NODE=S012;CLUMP=F
$\Gamma_{11} \mu^+ \mu^-$	$S1$ < 9×10^{-9}	CL=90%	DESIG=7
$\Gamma_{12} e^+ e^-$	$S1$ < 9×10^{-9}	CL=90%	DESIG=3
$\Gamma_{13} \pi^0 e^+ e^-$	$S1$ [a] ($3.0^{+1.5}_{-1.2}$) $\times 10^{-9}$		DESIG=4
$\Gamma_{14} \pi^0 \mu^+ \mu^-$	$S1$ ($2.9^{+1.5}_{-1.2}$) $\times 10^{-9}$		DESIG=10
			DESIG=15
[a] See the Particle Listings below for the energy limits used in this measurement.			
[b] Most of this radiative mode, the low-momentum γ part, is also included in the parent mode listed without γ 's.			
[c] The value is for the sum of the charge states or particle/antiparticle states indicated.			
[d] Not a measurement. Calculated as $0.666 \cdot B(\pi^\pm e^\mp \nu_e)$.			
			LINKAGE=KDS
			LINKAGE=KX
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			LINKAGE=NW

CONSTRAINED FIT INFORMATION

An overall fit to 4 branching ratios uses 5 measurements and one constraint to determine 4 parameters. The overall fit has a $\chi^2 = 0.1$ for 2 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients $\langle \delta x_i \delta x_j \rangle / (\delta x_i \cdot \delta x_j)$, in percent, from the fit to the branching fractions, $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$. The fit constrains the x_i whose labels appear in this array to sum to one.

$$\begin{array}{c|ccc} & x_2 & & \\ x_2 & -100 & & \\ & -6 & 3 & \\ x_8 & -6 & 3 & 100 \\ & x_1 & x_2 & x_8 \end{array}$$

 K_S^0 DECAY RATES

$\Gamma(\pi^\pm e^\mp \nu_e)$		Γ_8
<u>VALUE (10^6 s^{-1})</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>
• • • We do not use the following data for averages, fits, limits, etc. • • •		
8.1 ± 1.6	75	¹¹ AKHMETSHIN 99
7.50 ± 0.08		¹² PDG 98
seen		BURGUN 72
9.3 ± 2.5		AUBERT 65
		HLBC $K^+ p \rightarrow K^0 p \pi^+$
		$\Delta S = \Delta Q$, CP cons. not assumed

NODE=S012212

NODE=S012W1
NODE=S012W1

11 AKHMETSHIN 99 is from a measured branching ratio $B(K_S^0 \rightarrow \pi e \nu_e) = (7.2 \pm 1.4) \times 10^{-4}$ and $\tau_{K_S^0} = (0.8934 \pm 0.0008) \times 10^{-10}$ s. Not independent of measured branching ratio.

12 PDG 98 from K_L^0 measurements, assuming that $\Delta S = \Delta Q$ in K^0 decay so that $\Gamma(K_S^0 \rightarrow \pi^\pm e^\mp \nu_e) = \Gamma(K_L^0 \rightarrow \pi^\pm e^\mp \nu_e)$.

$\Gamma(\pi^\pm \mu^\mp \nu_\mu)$

VALUE (10^6 s^{-1})

DOCUMENT ID

Γ_9

• • • We do not use the following data for averages, fits, limits, etc. • • •

5.25 ± 0.07 13 PDG 98

13 PDG 98 from K_L^0 measurements, assuming that $\Delta S = \Delta Q$ in K^0 decay so that $\Gamma(K_S^0 \rightarrow \pi^\pm \mu^\mp \nu_\mu) = \Gamma(K_L^0 \rightarrow \pi^\pm \mu^\mp \nu_\mu)$.

K_S^0 BRANCHING RATIOS

Hadronic modes

$\Gamma(\pi^0 \pi^0)/\Gamma_{\text{total}}$

VALUE

EVTS

DOCUMENT ID

TECN

Γ_1/Γ

0.3069 ± 0.0005 OUR FIT

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.335 ± 0.014	1066	BROWN	63	HLBC
0.288 ± 0.021	198	CHRETIEN	63	HLBC
0.30 ± 0.035		BROWN	61	HLBC

$\Gamma(\pi^+ \pi^-)/\Gamma_{\text{total}}$

VALUE

EVTS

DOCUMENT ID

TECN

Γ_2/Γ

0.6920 ± 0.0005 OUR FIT

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.670 ± 0.010	3447	DOYLE	69	HBC $\pi^- p \rightarrow \Lambda K^0$
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$\Gamma(\pi^+ \pi^-)/(\pi^0 \pi^0)$

VALUE

EVTS

DOCUMENT ID

TECN

Γ_2/Γ_1

2.255 ± 0.005 OUR FIT

2.2549 ± 0.0054

14 AMBROSINO 06C KLOE

• • • We do not use the following data for averages, fits, limits, etc. • • •

2.2555 ± 0.0012 ± 0.0054	15	AMBROSINO	06C	KLOE
2.236 ± 0.003 ± 0.015	766k	15 ALOISIO	02B	KLOE
2.11 ± 0.09	1315	EVERHART	76	WIRE $\pi^- p \rightarrow \Lambda K^0$
2.169 ± 0.094	16k	COWELL	74	OSPK $\pi^- p \rightarrow \Lambda K^0$
2.16 ± 0.08	4799	HILL	73	DBC $K^+ d \rightarrow K^0 pp$
2.22 ± 0.10	3068	16 ALITTI	72	HBC $K^+ p \rightarrow \pi^+ p K^0$
2.22 ± 0.08	6380	MORSE	72B	DBC $K^+ n \rightarrow K^0 p$
2.10 ± 0.11	701	17 NAGY	72	HLBC $K^+ n \rightarrow K^0 p$
2.22 ± 0.095	6150	18 BALTAY	71	HBC $K p \rightarrow K^0_{\text{neutrals}}$
2.282 ± 0.043	7944	19 MOFFETT	70	OSPK $K^+ n \rightarrow K^0 p$
2.12 ± 0.17	267	17 BOZOKI	69	HLBC
2.285 ± 0.055	3016	19 GOBBI	69	OSPK $K^+ n \rightarrow K^0 p$
2.10 ± 0.06	3700	MORFIN	69	HLBC $K^+ n \rightarrow K^0 p$

14 This result combines AMBROSINO 06C KLOE 2001-02 data with ALOISIO 02B KLOE 2000 data. $K_S^0 \rightarrow \pi^+ \pi^-$ fully inclusive.

15 Includes radiative decays $\pi^+ \pi^- \gamma$.

16 The directly measured quantity is $K_S^0 \rightarrow \pi^+ \pi^- / \text{all } K^0 = 0.345 \pm 0.005$.

17 NAGY 72 is a final result which includes BOZOKI 69.

18 The directly measured quantity is $K_S^0 \rightarrow \pi^+ \pi^- / \text{all } \bar{K}^0 = 0.345 \pm 0.005$.

19 MOFFETT 70 is a final result which includes GOBBI 69.

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$\Gamma(\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$				Γ_3/Γ
VALUE (units 10^{-7})	EVTS	DOCUMENT ID	TECN	COMMENT
3.5$^{+1.1}_{-0.9}$ OUR AVERAGE				
4.7 $^{+2.2}_{-1.7}$ $^{+1.7}_{-1.5}$	20	BATLEY	05	NA48
2.5 $^{+1.3}_{-1.0}$ $^{+0.5}_{-0.6}$	500k	21 ADLER	97B	CPLR
4.8 $^{+2.2}_{-1.6}$ $^{+1.1}_{-1.1}$	22 ZOU	96	E621	
$\bullet \bullet \bullet$ We do not use the following data for averages, fits, limits, etc. $\bullet \bullet \bullet$				
4.1 $^{+2.5}_{-1.9}$ $^{+0.5}_{-0.6}$	23 ADLER	96E	CPLR	Sup. by ADLER 97B
3.9 $^{+5.4}_{-1.8}$ $^{+0.9}_{-0.7}$	24 THOMSON	94	E621	Sup. by ZOU 96

20 BATLEY 05 is obtained by measuring the interference parameters in K_S , $K_L \rightarrow \pi^+\pi^-\pi^0$: $\text{Re}(\lambda) = 0.038 \pm 0.008 \pm 0.006$ and $\text{Im}(\lambda) = -0.013 \pm 0.005 \pm 0.004$; the correlation coeff. between $\text{Re}(\lambda)$ and $\text{Im}(\lambda)$ is 0.66 (statistical only).

21 ADLER 97B find the CP-conserving parameters $\text{Re}(\lambda) = (28 \pm 7 \pm 3) \times 10^{-3}$, $\text{Im}(\lambda) = (-10 \pm 8 \pm 2) \times 10^{-3}$. They estimate $B(K_S^0 \rightarrow \pi^+\pi^-\pi^0)$ from $\text{Re}(\lambda)$ and the K_L^0 decay parameters. See also ANGELOPOULOS 98C.

22 ZOU 96 is from the measured quantities $|\rho_{+-0}| = 0.039^{+0.009}_{-0.006} \pm 0.005$ and $\phi_\rho = (-9 \pm 18)^\circ$.

23 ADLER 96E is from the measured quantities $\text{Re}(\lambda) = 0.036 \pm 0.010^{+0.002}_{-0.003}$ and $\text{Im}(\lambda)$ consistent with zero. Note that the quantity λ is the same as ρ_{+-0} used in other footnotes.

24 THOMSON 94 calculates this branching ratio from their measurements $|\rho_{+-0}| = 0.035^{+0.019}_{-0.011} \pm 0.004$ and $\phi_\rho = (-59 \pm 48)^\circ$ where $|\rho_{+-0}| e^{i\phi_\rho} = A(K_S^0 \rightarrow \pi^+\pi^-\pi^0, I=2) / A(K_L^0 \rightarrow \pi^+\pi^-\pi^0)$.

Modes with photons or $\ell\bar{\ell}$ pairs

$\Gamma(\pi^+\pi^-\gamma)/\Gamma(\pi^+\pi^-)$				Γ_4/Γ_2
VALUE (units 10^{-3})	EVTS	DOCUMENT ID	TECN	COMMENT
2.59± 0.08 OUR AVERAGE				
2.56 ± 0.09	1286	RAMBERG	93	E731 $p_\gamma > 50 \text{ MeV}/c$
2.68 ± 0.15	25 TAUREG	76	SPEC	$p_\gamma > 50 \text{ MeV}/c$
$\bullet \bullet \bullet$ We do not use the following data for averages, fits, limits, etc. $\bullet \bullet \bullet$				
7.10 ± 0.22	3723	RAMBERG	93	E731 $p_\gamma > 20 \text{ MeV}/c$
3.0 ± 0.6	29	26 BOBISUT	74	HLBC $p_\gamma > 40 \text{ MeV}/c$
2.8 ± 0.6		27 BURGUN	73	HBC $p_\gamma > 50 \text{ MeV}/c$

25 TAUREG 76 find direct emission contribution < 0.06 , CL = 90%.

26 BOBISUT 74 not included in average because p_γ cut differs. Estimates direct emission contribution to be 0.5 or less, CL = 95%.

27 BURGUN 73 estimates that direct emission contribution is 0.3 ± 0.6 .

$\Gamma(\pi^+\pi^-e^+e^-)/\Gamma_{\text{total}}$				Γ_5/Γ
VALUE (units 10^{-5})	EVTS	DOCUMENT ID	TECN	COMMENT
4.79± 0.15 OUR AVERAGE				
4.83 $\pm 0.11 \pm 0.14$	23k	28 BATLEY	11	NA48 2002 data
4.69 ± 0.30	676	29 LAI	03C	NA48 1998+1999 data
$\bullet \bullet \bullet$ We do not use the following data for averages, fits, limits, etc. $\bullet \bullet \bullet$				
4.71 $\pm 0.23 \pm 0.22$	620	29,30 LAI	03C	NA48 1999 data
4.5 $\pm 0.7 \pm 0.4$	56	LAI	00B	NA48 1998 data
28 BATLEY 11 reports $[\Gamma(K_S^0 \rightarrow \pi^+\pi^-e^+e^-)/\Gamma_{\text{total}}] / [B(K_L^0 \rightarrow \pi^+\pi^-\pi^0)] / [B(\pi^0 \rightarrow e^+e^-\gamma)] = (3.28 \pm 0.06 \pm 0.04) \times 10^{-2}$ which we multiply by our best values $B(K_L^0 \rightarrow \pi^+\pi^-\pi^0) = (12.54 \pm 0.05) \times 10^{-2}$, $B(\pi^0 \rightarrow e^+e^-\gamma) = (1.174 \pm 0.035) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best values. Also a limit on the absolute value of the interference between bremsstrahlung and E1 transition is given : $< 4 \times 10^{-7}$ at 90% C.L.				
29 Uses normalization $BR(K_L \rightarrow \pi^+\pi^-\pi^0) * BR(\pi^0 \rightarrow e^+e^-) = (1.505 \pm 0.047) \times 10^{-3}$ from our 2000 Edition.				
30 Second error is $0.16(\text{syst}) \pm 0.15(\text{norm})$ combined in quadrature.				

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$\Gamma(\pi^0 \gamma\gamma)/\Gamma_{\text{total}}$						Γ_6/Γ
VALUE (units 10^{-8})	CL%	EVTS	DOCUMENT ID	TECN	COMMENT	
4.9±1.6±0.9		17	31 LAI	04	NA48 $m_{\gamma\gamma}^2/m_K^2 > 0.2$	
<33	90	LAI	03B	NA48	$m_{\gamma\gamma}^2/m_K^2 > 0.2$	

- • • We do not use the following data for averages, fits, limits, etc. • • •
- <33 90 LAI 03B NA48 $m_{\gamma\gamma}^2/m_K^2 > 0.2$
- 31 Spectrum also measured and found consistent with the one generated by a constant matrix element.

$\Gamma(\gamma\gamma)/\Gamma_{\text{total}}$						Γ_7/Γ
VALUE (units 10^{-6})	CL%	EVTS	DOCUMENT ID	TECN	COMMENT	
2.63 ±0.17 OUR AVERAGE			Error includes scale factor of 3.0.			
2.26 ±0.12 ±0.06	711	32 AMBROSINO	08C KLOE	$\phi \rightarrow K_S^0 K_L^0$		
2.713±0.063±0.005	7.5k	33 LAI	03 NA48			

- • • We do not use the following data for averages, fits, limits, etc. • • •

2.58 ±0.36 ±0.22	149	LAI	00	NA48		
2.2 ±1.1	16	34 BARR	95B	NA31		
2.4 ±0.9	35	35 BARR	95B	NA31		
< 13	90	BALATS	89	SPEC		
2.4 ±1.2	19	BURKHARDT	87	NA31		
<133	90	BARMIN	86B	XEBC		

32 AMBROSINO 08C reports $(2.26 \pm 0.12 \pm 0.06) \times 10^{-6}$ from a measurement of $[\Gamma(K_S^0 \rightarrow \gamma\gamma)/\Gamma_{\text{total}}] \times [B(K_S^0 \rightarrow \pi^0 \pi^0)]$ assuming $B(K_S^0 \rightarrow \pi^0 \pi^0) = (30.69 \pm 0.05) \times 10^{-2}$.

33 LAI 03 reports $[\Gamma(K_S^0 \rightarrow \gamma\gamma)/\Gamma_{\text{total}}] / [B(K_S^0 \rightarrow \pi^0 \pi^0)] = (8.84 \pm 0.18 \pm 0.10) \times 10^{-6}$ which we multiply by our best value $B(K_S^0 \rightarrow \pi^0 \pi^0) = (30.69 \pm 0.05) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

34 BARR 95B result is calculated using $B(K_L \rightarrow \gamma\gamma) = (5.86 \pm 0.17) \times 10^{-4}$.

35 BARR 95B quotes this as the combined BARR 95B + BURKHARDT 87 result after rescaling BURKHARDT 87 to use same branching ratios and lifetimes as BARR 95B.

Semileptonic modes

$\Gamma(\pi^\pm e^\mp \nu_e)/\Gamma_{\text{total}}$						Γ_8/Γ
VALUE (units 10^{-4})	EVTS	DOCUMENT ID	TECN	COMMENT		
7.04 ±0.08 OUR FIT						

7.04 ±0.08 OUR AVERAGE

7.046±0.18±0.16	36 BATLEY	07D NA48	$K^0 (\bar{K}^0)(t) \rightarrow \pi e \nu$			
6.91 ±0.34±0.15	624 37 ALOISIO	02 KLOE	Tagged K_S^0 using $\phi \rightarrow K_L^0 K_S^0$			

- • • We use the following data for averages but not for fits. • • •

7.05 ±0.09	13k 38 AMBROSINO	06E KLOE	Not fitted			
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- • • We do not use the following data for averages, fits, limits, etc. • • •

7.2 ±1.4	75 AKHMETSHIN 99	CMD2	Tagged K_S^0 using $\phi \rightarrow K_L^0 K_S^0$			
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36 Reconstructed from $K^0 (\bar{K}^0)(t) \rightarrow \pi e \nu$ distributions using PDG values of $B(K_L^0 \rightarrow \pi e \nu) = 0.4053 \pm 0.0015$, $\tau_L = (5.114 \pm 0.021) \times 10^{-8}$ s and $\tau_S = (0.8958 \pm 0.0005) \times 10^{-10}$ s.

37 Uses the PDG 00 value for $B(K_S^0 \rightarrow \pi^+ \pi^-)$.

38 Obtained by imposing $\sum_i B(K_S^0 \rightarrow i) = 1$, where i runs over all the four branching ratios $\pi^+ \pi^-$, $\pi^0 \pi^0$, $\pi e \nu$, and $\pi \mu \nu$. Input value of $B(K_S^0 \rightarrow \pi^+ \pi^-) / B(K_S^0 \rightarrow \pi^0 \pi^0)$ from AMBROSINO 06E is used. To derive $\Gamma(K_S^0 \rightarrow \pi^+ \mu \nu) / \Gamma(K_S^0 \rightarrow \pi^+ e \nu)$, lepton universality is assumed, radiative corrections from ANDRE 07 are used, and phase space integrals are taken from KTeV, ALEXOPOULOS 04A. This branching fraction enters our fit via their $\Gamma(\pi^\pm e^\mp \nu_e) / \Gamma(\pi^+ \pi^-)$ branching ratio measurement.

$\Gamma(\pi^\pm \mu^\mp \nu_\mu)/\Gamma_{\text{total}}$						Γ_9/Γ
VALUE (units 10^{-4})	DOCUMENT ID	COMMENT				
4.69 ±0.06 OUR FIT						

4.691±0.001±0.056	39 PDG	06	calculated from $\pi^\pm e^\mp \nu_e$			
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NODE=S012R18

39 The PDG 06 value is computed to be $B_{\text{PDG}06}(\pi\mu\nu) = 0.666 B_{\text{FIT}}(\pi e\nu)$. The first error specifies the arbitrarily small error, 0.001×10^{-4} , on $B_{\text{PDG}06}(\pi\mu\nu)$ for fixed $B_{\text{FIT}}(\pi e\nu)$. The second error is that due to the uncertainty in $B_{\text{FIT}}(\pi e\nu)$.

$\Gamma(\pi^\pm e^\mp \nu_e)/\Gamma(\pi^+\pi^-)$

VALUE (units 10^{-4})	EVTS	DOCUMENT ID	TECN
10.18 ± 0.12 OUR FIT			
$10.19 \pm 0.11 \pm 0.07$	13k	AMBROSINO 06E	KLOE

Γ_8/Γ_2

NODE=S012R17
NODE=S012R17

CP violating (CP) and $\Delta S = 1$ weak neutral current (S1) modes

$\Gamma(3\pi^0)/\Gamma_{\text{total}}$

Violates CP conservation.

VALUE (units 10^{-7})	CL%	EVTS	DOCUMENT ID	TECN
< 1.2	90	37.8M	AMBROSINO 05B	KLOE

• • • We do not use the following data for averages, fits, limits, etc. • • •

< 7.4	90	4.9M	40 LAI	05A NA48
< 140	90	7M	ACHASOV	99D SND
< 190	90	17300	41 ANGELOPO...	98B CPLR
< 370	90		BARMIN	83 HLBC

40 LAI 05A value is obtained from their bound on $|\eta_{000}|$ (not assuming CPT) and $B(K_L^0 \rightarrow 3\pi^0) = 0.211 \pm 0.003$, and PDG 04 values for K_L^0 and K_S^0 lifetimes. If CPT is assumed then $B(K_S^0 \rightarrow 3\pi^0)_{CPT} < 2.3 \times 10^{-7}$ at 90% CL

41 ANGELOPOULOS 98B is from $\text{Im}(\eta_{000}) = -0.05 \pm 0.12 \pm 0.05$, assuming $\text{Re}(\eta_{000}) = \text{Re}(\epsilon) = 1.635 \times 10^{-3}$ and using the value $B(K_L^0 \rightarrow \pi^0 \pi^0 \pi^0) = 0.2112 \pm 0.0027$.

$\Gamma(\mu^+ \mu^-)/\Gamma_{\text{total}}$

Γ_{10}/Γ

Test for $\Delta S = 1$ weak neutral current. Allowed by first-order weak interaction combined with electromagnetic interaction.

VALUE (units 10^{-9})	CL%	EVTS	DOCUMENT ID	TECN
<9 (CL = 90%)	[<0.032 $\times 10^{-5}$ (CL = 90%) OUR 2012 BEST LIMIT]			

<9	90	42 AAIJ	13G LHCb
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• • • We do not use the following data for averages, fits, limits, etc. • • •

$< 3.2 \times 10^2$	90	GJESDAL	73 ASPK
$< 7 \times 10^3$	90	HYAMS	69B OSPK

42 AAIJ 13G uses 1.0 fb^{-1} of pp collisions at $\sqrt{s} = 7 \text{ TeV}$. They obtained $B(K_S^0 \rightarrow \mu^+ \mu^-) < 11 \times 10^{-9}$ at 95% C.L.

Γ_{11}/Γ

NODE=S012R9;LINKAGE=LA

$\Gamma(e^+ e^-)/\Gamma_{\text{total}}$

Γ_{11}/Γ

NODE=S012R9;LINKAGE=A

Test for $\Delta S = 1$ weak neutral current. Allowed by first-order weak interaction combined with electromagnetic interaction.

VALUE (units 10^{-7})	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
< 0.09	90	43 AMBROSINO	09A KLOE	$e^+ e^- \rightarrow \phi \rightarrow K_S^0 K_L^0$	

• • • We do not use the following data for averages, fits, limits, etc. • • •

< 1.4	90	ANGELOPO...	97 CPLR
< 28	90	BLICK	94 CNTR Hyperon facility
< 100	90	BARMIN	86 XEBC

43 AMBROSINO 09A reports $< 0.09 \times 10^{-7}$ from a measurement of $[\Gamma(K_S^0 \rightarrow e^+ e^-)/\Gamma_{\text{total}}]/[B(K_S^0 \rightarrow \pi^+ \pi^-)]$ assuming $B(K_S^0 \rightarrow \pi^+ \pi^-) = (69.20 \pm 0.05) \times 10^{-2}$.

Γ_{12}/Γ

NODE=S012R11

NODE=S012R11

$\Gamma(\pi^0 e^+ e^-)/\Gamma_{\text{total}}$

Γ_{12}/Γ

NODE=S012R12

Test for $\Delta S = 1$ weak neutral current. Allowed by first-order weak interaction combined with electromagnetic interaction.

VALUE (units 10^{-9})	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
$3.0^{+1.5}_{-1.2} \pm 0.2$	7	44 BATLEY	03 NA48	$m_{ee} > 0.165 \text{ GeV}$	

• • • We do not use the following data for averages, fits, limits, etc. • • •

< 140	90	LAI	01 NA48
< 1100	90	0 BARR	93B NA31
< 45000	90	GIBBONS	88 E731

44 BATLEY 03 extrapolate also to the full kinematical region using a constant form factor and a vector matrix element. The resulting branching ratio is $(5.8^{+2.9}_{-2.4}) \times 10^{-9}$.

Γ_{13}/Γ

NODE=S012R12

NODE=S012R12

NODE=S012R12

NODE=S012R12;LINKAGE=AM

NODE=S012R10

NODE=S012R10

NODE=S012R10

NODE=S012R10;LINKAGE=BA

$\Gamma(\pi^0 \mu^+ \mu^-)/\Gamma_{\text{total}}$

Test for $\Delta S = 1$ weak neutral current. Allowed by first-order weak interaction combined with electromagnetic interaction.

VALUE (units 10^{-9})	EVTS	DOCUMENT ID	TECN	COMMENT
$2.9^{+1.5}_{-1.2} \pm 0.2$	6	45 BATLEY	04A NA48	NA48/1 K_S^0 beam

45 Background estimate is $0.22^{+0.18}_{-0.11}$ events. Branching ratio assumes a vector matrix element and unit form factor.

 Γ_{14}/Γ

NODE=S012R16

NODE=S012R16

NODE=S012R16

NODE=S012R16;LINKAGE=BA

 K_S^0 FORM FACTORS

For discussion, see note on K_{e3} form factors in the K^\pm section of the Particle Listings above. Because the semileptonic branching fraction is smaller in K_S^0 than K_L^0 by the ratio of the mean lives, the K_S^0 semileptonic form factor has so far been measured only in the K_{e3} mode using the linear expansion $f_+(t) = f_+(0) (1 + \lambda_+ t / m_{\pi^+}^2)$, which gives the vector form factor $f_+(t)$ relative to its value at $t = 0$.

 λ_+ (LINEAR ENERGY DEPENDENCE OF f_+ IN K_{e3}^0 DECAY)

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN
3.39 ± 0.41	15k	AMBROSINO	06E KLOE

NODE=S012L+E

NODE=S012L+E

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CP-VIOLATION PARAMETERS IN K_S^0 DECAY

$$A_S = [\Gamma(K_S^0 \rightarrow \pi^- e^+ \nu_e) - \Gamma(K_S^0 \rightarrow \pi^+ e^- \bar{\nu}_e)] / \text{SUM}$$

Such asymmetry violates CP. If CPT is assumed then $A_S = 2 \operatorname{Re}(\epsilon)$.

VALUE (units 10^{-3})	EVTS	DOCUMENT ID	TECN
$1.5 \pm 9.6 \pm 2.9$	13k	AMBROSINO	06E KLOE

NODE=S012219

NODE=S012250

NODE=S012AS

NODE=S012AS

NODE=S012AS

PARAMETERS FOR $K_S^0 \rightarrow 3\pi$ DECAY

$$\operatorname{Im}(\eta_{+-0})^2 = \Gamma(K_S^0 \rightarrow \pi^+ \pi^- \pi^0, \text{CP-violating}) / \Gamma(K_L^0 \rightarrow \pi^+ \pi^- \pi^0)$$

CPT assumed valid (i.e. $\operatorname{Re}(\eta_{+-0}) \approx 0$).

VALUE	CL%	EVTS	DOCUMENT ID	TECN
• • • We do not use the following data for averages, fits, limits, etc. • • •				

<0.23	90	601	46 BARMIN	85 HLBC
<0.12	90	384	METCALF	72 ASPK

46 BARMIN 85 find $\operatorname{Re}(\eta_{+-0}) = (0.05 \pm 0.17)$ and $\operatorname{Im}(\eta_{+-0}) = (0.15 \pm 0.33)$. Includes events of BALDO-CEOLIN 75.

NODE=S012220

NODE=S012ET+

NODE=S012ET+

NODE=S012ET+

$$\operatorname{Im}(\eta_{+-0}) = \operatorname{Im}(A(K_S^0 \rightarrow \pi^+ \pi^- \pi^0, \text{CP-violating}) / A(K_L^0 \rightarrow \pi^+ \pi^- \pi^0))$$

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
$-0.002 \pm 0.002 \pm 0.009$	500k	47 ADLER	97B CPLR	

NODE=S012ET+;LINKAGE=B

NODE=S012E+

NODE=S012E+

• • • We do not use the following data for averages, fits, limits, etc. • • •				
-0.002 $\pm 0.018 \pm 0.003$	137k	48 ADLER	96D CPLR	Sup. by ADLER 97B

-0.015 $\pm 0.017 \pm 0.025$	272k	49 ZOU	94 SPEC	
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47 ADLER 97B also find $\operatorname{Re}(\eta_{+-0}) = -0.002 \pm 0.007^{+0.004}_{-0.001}$. See also ANGELOPOULOS 98C.

48 The ADLER 96D fit also yields $\operatorname{Re}(\eta_{+-0}) = 0.006 \pm 0.013 \pm 0.001$ with a correlation $+0.66$ between real and imaginary parts. Their results correspond to $|\eta_{+-0}| < 0.037$ with 90% CL.

49 ZOU 94 use theoretical constraint $\operatorname{Re}(\eta_{+-0}) = \operatorname{Re}(\epsilon) = 0.0016$. Without this constraint they find $\operatorname{Im}(\eta_{+-0}) = 0.019 \pm 0.061$ and $\operatorname{Re}(\eta_{+-0}) = 0.019 \pm 0.027$.

NODE=S012E+;LINKAGE=C

NODE=S012E+;LINKAGE=B

NODE=S012E+;LINKAGE=A

$$\text{Im}(\eta_{000})^2 = \Gamma(K_S^0 \rightarrow 3\pi^0) / \Gamma(K_L^0 \rightarrow 3\pi^0)$$

CPT assumed valid (i.e. $\text{Re}(\eta_{000}) \simeq 0$). This limit determines branching ratio $\Gamma(3\pi^0)/\Gamma_{\text{total}}$ above.

VALUE	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
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• • • We do not use the following data for averages, fits, limits, etc. • • •

<0.1	90	632	50 BARMIN	83 HLBC	
<0.28	90		51 GJESDAL	74B SPEC	Indirect meas.

50 BARMIN 83 find $\text{Re}(\eta_{000}) = (-0.08 \pm 0.18)$ and $\text{Im}(\eta_{000}) = (-0.05 \pm 0.27)$. Assuming *CPT* invariance they obtain the limit quoted above.

51 GJESDAL 74B uses $K2\pi$, $K_{\mu 3}$, and K_{e3} decay results, unitarity, and *CPT*. Calculates $|\eta_{000}| = 0.26 \pm 0.20$. We convert to upper limit.

$$\text{Im}(\eta_{000}) = \text{Im}(A(K_S^0 \rightarrow \pi^0 \pi^0 \pi^0) / A(K_L^0 \rightarrow \pi^0 \pi^0 \pi^0))$$

$K_S^0 \rightarrow \pi^0 \pi^0 \pi^0$ violates *CP* conservation, in contrast to $K_S^0 \rightarrow \pi^+ \pi^- \pi^0$ which has a *CP*-conserving part.

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
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(-0.1 ± 1.6) × 10⁻² OUR AVERAGE

0.000 ± 0.009 ± 0.013	4.9M	52 LAI	05A NA48	Assumes <i>CPT</i>
-0.05 ± 0.12 ± 0.05	17300	53 ANGELOPO...	98B CPLR	Assumes <i>CPT</i>
52 LAI 05A assumes $\text{Re}(\eta_{000}) = \text{Re}(\epsilon) = 1.66 \times 10^{-3}$. The equivalent limit is $ \eta_{000} _{CPT} < 0.025$ at 90% CL. Without assuming <i>CPT</i> invariance, they obtain $\text{Re}(\eta_{000}) = -0.002 \pm 0.011 \pm 0.015$ and $\text{Im}(\eta_{000}) = -0.003 \pm 0.013 \pm 0.017$ with a statistical correlation coefficient of 0.77 and an overall correlation coefficient of 0.57 between imaginary and real part. The equivalent limit is $ \eta_{000} < 0.045$ at 90% CL				
53 ANGELOPOULOS 98B assumes $\text{Re}(\eta_{000}) = \text{Re}(\epsilon) = 1.635 \times 10^{-3}$. Without assuming <i>CPT</i> invariance, they obtain $\text{Re}(\eta_{000}) = 0.18 \pm 0.14 \pm 0.06$ and $\text{Im}(\eta_{000}) = 0.15 \pm 0.20 \pm 0.03$.				

$$|\eta_{000}| = |A(K_S^0 \rightarrow 3\pi^0) / A(K_L^0 \rightarrow 3\pi^0)|$$

A non-zero value violates *CP* invariance.

VALUE	CL%	EVTS	DOCUMENT ID	TECN
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<0.018	90	37.8M	AMBROSINO 05B	KLOE
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• • • We do not use the following data for averages, fits, limits, etc. • • •

<0.045	90	4.9M	LAI	05A NA48
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DECAY-PLANE ASYMMETRY IN $\pi^+ \pi^- e^+ e^-$ DECAYS

This is the *CP*-violating asymmetry

$$A = \frac{N_{\sin\phi\cos\phi>0.0} - N_{\sin\phi\cos\phi<0.0}}{N_{\sin\phi\cos\phi>0.0} + N_{\sin\phi\cos\phi<0.0}}$$

where ϕ is the angle between the $e^+ e^-$ and $\pi^+ \pi^-$ planes in the K_S^0 rest frame.

$$\text{CP asymmetry } A \text{ in } K_S^0 \rightarrow \pi^+ \pi^- e^+ e^-$$

VALUE (%)	DOCUMENT ID	TECN	COMMENT
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-0.4 ± 0.8 OUR AVERAGE

-0.4 ± 0.8	54 BATLEY	11 NA48	2002 data
-1.1 ± 4.1	LAI	03C NA48	1998+1999 data

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.5 ± 4.0 ± 1.6	LAI	03C NA48	1999 data
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54 The result is used to set the limit $A < 1.5\%$ at 90% C.L.

K_S^0 REFERENCES

AAIJ	13G	JHEP 1301 090	R. Aaij <i>et al.</i>	(LHCb Collab.)
ABOUZAID	11	PR D83 092001	E. Abouzaid <i>et al.</i>	(FNAL KTeV Collab.)
AMBROSINO	11	EPJ C71 1604	F. Ambrosino <i>et al.</i>	(KLOE Collab.)
BATLEY	11	PL B694 301	J.R. Batley <i>et al.</i>	(CERN NA48/1 Collab.)
AMBROSINO	09A	PL B672 203	F. Ambrosino <i>et al.</i>	(KLOE Collab.)
AMBROSINO	08C	JHEP 0805 051	F. Ambrosino <i>et al.</i>	(KLOE Collab.)
ANDRE	07	ANP 322 2518	T. Andre	(IFI)
BATLEY	07D	PL B653 145	J.R. Batley <i>et al.</i>	(CERN NA48 Collab.)
AMBROSINO	06C	EPJ C48 767	F. Ambrosino <i>et al.</i>	(KLOE Collab.)
AMBROSINO	06E	PL B636 173	F. Ambrosino <i>et al.</i>	(KLOE Collab.)
PDG	06	JPG 33 1	W.-M. Yao <i>et al.</i>	(PDG Collab.)
AMBROSINO	05B	PL B619 61	F. Ambrosino <i>et al.</i>	(KLOE Collab.)
BATLEY	05	PL B630 31	J.R. Batley <i>et al.</i>	(NA48 Collab.)
LAI	05A	PL B610 165	A. Lai <i>et al.</i>	(CERN NA48 Collab.)
ALEXOPOU...	04A	PR D70 092007	T. Alexopoulos <i>et al.</i>	(FNAL KTeV Collab.)
BATLEY	04A	PL B599 197	J.R. Batley <i>et al.</i>	(NA48 Collab.)
LAI	04	PL B578 276	A. Lai <i>et al.</i>	(CERN NA48 Collab.)
PDG	04	PL B592 1	S. Eidelman <i>et al.</i>	(PDG Collab.)

NODE=S012ETO

NODE=S012ETO

NODE=S012ETO

NODE=S012ETO;LINKAGE=B

NODE=S012ETO;LINKAGE=G

NODE=S012E0

NODE=S012E0

NODE=S012E0

NODE=S012E0;LINKAGE=LA

NODE=S012E0;LINKAGE=A

NODE=S012AE0

NODE=S012AE0

NODE=S012AE0

NODE=S012230

NODE=S012230

NODE=S012DPA

NODE=S012DPA

OCCUR=2

NODE=S012DPA;LINKAGE=BA

NODE=S012

REFID=54858

REFID=53712

REFID=16403

REFID=53568

REFID=52835

REFID=52321

REFID=50524

REFID=51876

REFID=51068

REFID=51073

REFID=51004

REFID=50682

REFID=50953

REFID=50597

REFID=50243

REFID=50127

REFID=49654

REFID=49653

ALAVI-HARATI	03	PR D67 012005	A. Alavi-Harati <i>et al.</i>	(FNAL KTeV Collab.)	REFID=49244
Also		PR D70 079904 (errat.)	A. Alavi-Harati <i>et al.</i>	(FNAL KTeV Collab.)	REFID=50236
BATLEY	03	PL B576 43	J.R. Batley <i>et al.</i>	(CERN NA48 Collab.)	REFID=49534
LAI	03	PL B551 7	A. Lai <i>et al.</i>	(CERN NA48 Collab.)	REFID=49148
LAI	03B	PL B556 105	A. Lai <i>et al.</i>	(CERN NA48 Collab.)	REFID=49257
LAI	03C	EPJ C30 33	A. Lai <i>et al.</i>	(CERN NA48 Collab.)	REFID=49502
ALOISIO	02	PL B535 37	A. Aloisio <i>et al.</i>	(KLOE Collab.)	REFID=48727
ALOISIO	02B	PL B538 21	A. Aloisio <i>et al.</i>	(KLOE Collab.)	REFID=48770
LAI	02C	PL B537 28	A. Lai <i>et al.</i>	(CERN NA48 Collab.)	REFID=48765
LAI	01	PL B514 253	A. Lai <i>et al.</i>	(CERN NA48 Collab.)	REFID=48191
LAI	00	PL B493 29	A. Lai <i>et al.</i>	(CERN NA48 Collab.)	REFID=47830
LAI	00B	PL B496 137	A. Lai <i>et al.</i>	(CERN NA48 Collab.)	REFID=47921
PDG	00	EPJ C15 1	D.E. Groom <i>et al.</i>		REFID=47469
ACHASOV	99D	PL B459 674	M.N. Achasov <i>et al.</i>		REFID=47048
AKHMETSHIN	99	PL B456 90	R.R. Akhmetshin <i>et al.</i>	(Novosibirsk CMD-2 Collab.)	REFID=47032
ANGELOPO...	98B	PL B425 391	A. Angelopoulos <i>et al.</i>	(CPLEAR Collab.)	REFID=46084
ANGELOPO...	98C	EPJ C5 389	A. Angelopoulos <i>et al.</i>	(CPLEAR Collab.)	REFID=46264
PDG	98	EPJ C3 1	C. Caso <i>et al.</i>		REFID=45838
ADLER	97B	PL B407 193	R. Adler <i>et al.</i>	(CPLEAR Collab.)	REFID=45617
ANGELOPO...	97	PL B413 232	A. Angelopoulos <i>et al.</i>	(CPLEAR Collab.)	REFID=45750
BERTANZA	97	ZPHY C73 629	L. Bertanza (PISA, CERN, EDIN, MANZ, ORSAY+)		REFID=45296
ADLER	96D	PL B370 167	R. Adler <i>et al.</i>	(CPLEAR Collab.)	REFID=44839
ADLER	96E	PL B374 313	R. Adler <i>et al.</i>	(CPLEAR Collab.)	REFID=44892
ZOU	96	PL B369 362	Y. Zou <i>et al.</i>	(RUTG, MINN, MICH)	REFID=44835
BARR	95B	PL B351 579	G.D. Barr <i>et al.</i>	(CERN, EDIN, MANZ, LALO+)	REFID=44282
SCHWINGEN...	95	PRL 74 4376	B. Schwingenheuer <i>et al.</i>	(EFI, CHIC+)	REFID=44259
BLICK	94	PL B334 234	A.M. Blöck <i>et al.</i>	(SERP, JINR)	REFID=43957
THOMSON	94	PL B337 411	G.B. Thomson <i>et al.</i>	(RUTG, MINN, MICH)	REFID=44020
ZOU	94	PL B329 519	Y. Zou <i>et al.</i>	(RUTG, MINN, MICH)	REFID=43893
BARR	93B	PL B304 381	G.D. Barr <i>et al.</i>	(CERN, EDIN, MANZ, LALO+)	REFID=43338
GIBBONS	93	PRL 70 1199	L.K. Gibbons <i>et al.</i>	(FNAL E731 Collab.)	REFID=43209
Also		PR D55 6625	L.K. Gibbons <i>et al.</i>	(FNAL E731 Collab.)	REFID=45465
RAMBERG	93	PR D70 2525	E. Ramberg <i>et al.</i>	(FNAL E731 Collab.)	REFID=43263
BALATS	89	SJNP 49 828	M.Y. Balats <i>et al.</i>	(ITEP)	REFID=40977
		Translated from YAF 49	1332.		
GIBBONS	88	PRL 61 2661	L.K. Gibbons <i>et al.</i>	(FNAL E731 Collab.)	REFID=40624
BURKHARDT	87	PL B199 139	H. Burkhardt <i>et al.</i>	(CERN, EDIN, MANZ+)	REFID=40237
GROSSMAN	87	PRL 59 18	N. Grossman <i>et al.</i>	(MINN, MICH, RUTG)	REFID=40230
BARMIN	86	SJNP 44 622	V.V. Barmin <i>et al.</i>	(ITEP)	REFID=40228
		Translated from YAF 44	965.		
BARMIN	86B	NC 96A 159	V.V. Barmin <i>et al.</i>	(ITEP, PADO)	REFID=40231
PDG	86B	PL 170B 130	M. Aguilar-Benitez <i>et al.</i>	(CERN, CIT+)	REFID=41168
BARMIN	85	NC 85A 67	V.V. Barmin <i>et al.</i>	(ITEP, PADO)	REFID=11119
Also		SJNP 41 759	V.V. Barmin <i>et al.</i>	(ITEP)	REFID=11120
		Translated from YAF 41	1187.		
BARMIN	83	PL 128B 129	V.V. Barmin <i>et al.</i>	(ITEP, PADO)	REFID=11117
Also		SJNP 39 269	V.V. Barmin <i>et al.</i>	(ITEP, PADO)	REFID=11118
		Translated from YAF 39	428.		
ARONSON	82	PR D48 1078	S.H. Aronson <i>et al.</i>	(BNL, CHIC, STAN+)	REFID=11411
ARONSON	82B	PRL 48 1306	S.H. Aronson <i>et al.</i>	(BNL, CHIC, PURD)	REFID=11401
Also		PL 116B 73	E. Fischbach <i>et al.</i>	(PURD, BNL, CHIC)	REFID=11402
Also		PR D28 476	S.H. Aronson <i>et al.</i>	(BNL, CHIC, PURD)	REFID=11403
Also		PR D28 495	S.H. Aronson <i>et al.</i>	(BNL, CHIC, PURD)	REFID=11404
ARONSON	76	NC 32A 236	S.H. Aronson <i>et al.</i>	(WISC, EFI, UCSD+)	REFID=11110
EVERHART	76	PR D14 661	G.C. Everhart <i>et al.</i>	(PENN)	REFID=11111
TAUREG	76	PL 65B 92	H. Taureg <i>et al.</i>	(HEIDH, CERN, DORT)	REFID=11112
BALDO...	75	NC 25A 688	M. Baldo-Ceolin <i>et al.</i>	(PADO, WISC)	REFID=11108
CARTHERS	75	PRL 34 1244	W.C.J. Carithers <i>et al.</i>	(COLU, NYU)	REFID=11109
BOBISUT	74	LNC 11 646	F. Bobisut <i>et al.</i>	(PADO)	REFID=11104
COWELL	74	PR D10 2083	P.L. Cowell <i>et al.</i>	(STON, COLU)	REFID=11105
GEWENIGER	74B	PL 48B 487	C. Geweniger <i>et al.</i>	(CERN, HEIDH)	REFID=11357
GJESDAL	74B	PL 52B 119	S. Gjeddal <i>et al.</i>	(CERN, HEIDH)	REFID=11358
BURGUN	73	PL 46B 481	G. Burgun <i>et al.</i>	(SACL, CERN)	REFID=11099
GJESDAL	73	PL 44B 217	S. Gjeddal <i>et al.</i>	(CERN, HEIDH)	REFID=11101
HILL	73	PR D8 1290	D.G. Hill <i>et al.</i>	(BNL, CMU)	REFID=11102
ALITTI	72	PL 39B 568	J. Alitti, E. Lesquoy, A. Muller	(SACL)	REFID=11088
BURGUN	72	NP B50 194	G. Burgun <i>et al.</i>	(SACL, CERN, OSLO)	REFID=11306
METCALF	72	PL 40B 703	M. Metcalf <i>et al.</i>	(CERN, IPN, WIEN)	REFID=11092
MORSE	72B	PRL 28 388	R. Morse <i>et al.</i>	(COLO, PRIN, UMD)	REFID=11093
NAGY	72	NP B47 94	E. Nagy, F. Telbisz, G. Vesztergombi	(BUDA)	REFID=11094
Also		PL 30B 498	G. Bozoki <i>et al.</i>	(BUDA)	REFID=11095
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